2007

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Thomas M. Franklin Franklin
Theodore Roosevelt Conservation Partnership, tfranklin@trcp.org

Ronald Helinski Helinski
Theodore Roosevelt Conservation Partnership, tabascocat2@verizon.net

Andrew Manale Manale
U.S. Environmental Protection Agency, manale.andrew@epa.gov

Produced by The Wildlife Society in partnership with NRCS and FSA (2007).
Online at: http://www.nrcs.usda.gov/TECHNICAL/nri/ceap/fwresponse.html

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Thomas M. Franklin, Theodore Roosevelt Conservation Partnership

555 Eleventh Street, NW
Washington, DC 20004
Email: tfranklin@trcp.org

Ronald Helinski

1230 Quaker Ridge Drive
Arnold, MD 21012
Email: tabascocat2@verizon.net

Andrew Manale, U.S. Environmental Protection Agency

National Center for Environmental Economics
Ariel Rios Building (1809T)
1200 Pennsylvania Avenue, NW
Washington, DC 20460
Email: manale.andrew@epa.gov

ABSTRACT Natural resource professionals should know whether or not they are doing an effective job of managing natural resources. Their decision-making process should produce the kind of results desired by the public, elected officials, and their agencies' leadership. With billions of dollars spent each year on managing natural resources, accountability is more important than ever. Producing results is the key to success. Managers must have the necessary data to make enlightened decisions during program implementation—not just at the conclusion of a program. Adaptive management is described as an adapt-and-learn methodology as it pertains to implementing Farm Bill conservation practices. Four regional case studies describe how adaptive management is being applied by practicing fish and wildlife managers. Indicators were identified to monitor and evaluate contributions to fish and wildlife habitat for each of the case studies. Data collected at each stage of the studies were used to make mid-course adjustments that enabled leadership to improve or enhance ongoing management actions.

As a natural resource professional with a federal or state government or conservation non-governmental organization (NGO), how do you know that you are doing the best job of managing natural resources? You have a responsibility to inform your constituents about how well your programs are contributing to conservation goals and objectives. Sounds like common sense, but in today's world of tightening budgets, constant change, unpredictable political environments, and high expectations by the public, we often fail to demonstrate results. Decision-makers may want monitoring and evaluation of programs and use of adaptive management in program implementation, but they often allocate too few resources to make it happen.

Since both elected officials and the public are now focused on accountability, we have to produce results. If you haven't been asked to provide information on the effectiveness of your projects and programs, you soon will be. The key lies in having the necessary data both to make decisions and to communicate the information to your constituents. Adaptive management, including monitoring and evaluation, is critical to successful conservation. After reading this chapter, we hope that you will be inspired to integrate adaptive management into your decisions and management activities.

Billions of dollars are spent each year on managing our natural resources. As accountability becomes more important, we'll need to make better decisions not just on how we use those dollars, but also on helping the public understand how they benefit from the work of natural resource professionals. The responsibility lies with leadership and management to make good decisions. Those decisions should be based on the best science, and that science comes from research that should include a monitoring and evaluation component. Adaptive management enhances the quality of the data. With better information, better decisions can be made.

Adaptive Management and Monitoring/ Evaluation Basics

Adaptive management, focused on monitoring and evaluation, can help you improve your natural resource management decisions. This section answers the basic question on how these concepts apply to your work.

What Is Adaptive Management?

Adaptive management is a relatively new concept that has begun to gain popularity in the mainstream conservation community. Adaptive management incorporates research into conservation action. Specifically, adaptive management is the integration of design, management, and monitoring to systematically test assumptions in order to adapt and learn (Salafsky et al. 2001). Adaptive management is the process of hypothesizing how ecosystems work, monitoring results, comparing them with expectations and modifying management decisions to better achieve conservation objectives through improved understanding of ecological processes (Lancia et al. 1996).

An adaptive management approach deals with the uncertainty inherent in managing natural ecosystems by treating policies or practices as experiments. Below is a definition of the concept:

Adaptive management is an approach to natural resource policy that embodies a simple imperative: polices are experiments; learn from them. In order to live we use resources of the world, but we do not understand nature well enough to know how to live harmoniously within environmental limits. Adaptive management takes uncertainty seriously, treating human interventions in natural ecosystems as experimental probes. Its practitioners take special care with information. First, they are explicit about what they expect, so that they can design methods and apparatus to make measurements. Second, they collect and analyze information so that expectations can be compared with actuality. Finally, they transform comparison into learning—they correct errors, improve their imperfect understanding, and change action and plans. Linking science and human purpose, adaptive management serves as a compass for us to use in searching for a sustainable future (Lee 1993).

Adaptive management incorporates research into conservation action. In a conservation project context, adaptive management is about systematically trying different actions to achieve a desired outcome. It is not, however, a random trial-and-error process. Instead, adaptive management is a cycle that involves several specific steps:

START: Establish a clear and common purpose

STEP A: Design an explicit model of your system

STEP B: Develop a management plan that maximizes results and learning

STEP C: Develop a monitoring plan to test your assumptions

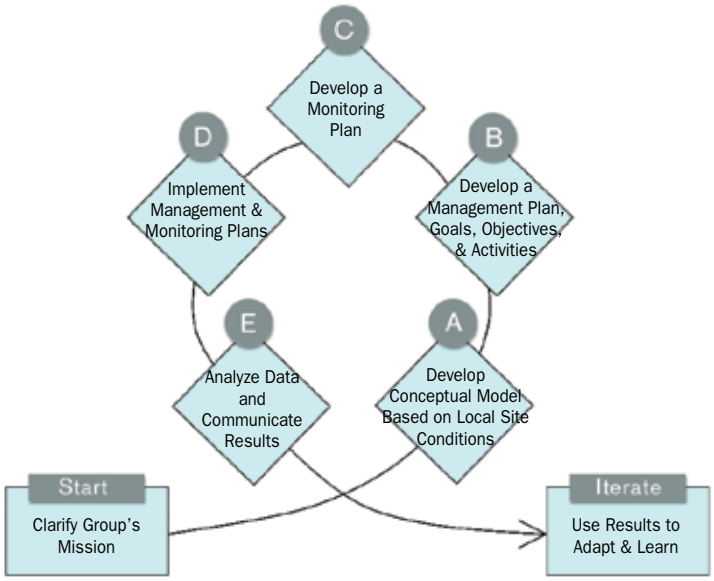
STEP D: Implement your management and monitoring plans

STEP E: Compare result to hypothesis

ITERATE: Use results to adapt and learn

Adaptive management encourages research and management to be conducted simultaneously to reduce uncertainty and improve management and ecological understanding. Administrators can benefit from funding sound management experiments because they can gauge the effectiveness of various management scenarios and can improve understanding of why a particular action succeeds or fails (Lancia et al. 1996).

Figure 1. The Adaptive Management Cycle



Source: Adapted from Margoluis & Salafsky 1998.

Why is Adaptive Management Important?

Adaptive management is a tool that enables natural resource agencies or organizations to evaluate how they are meeting their short-term and long-term natural resource goals. It allows us to answer basic questions: Is our management of the land working? Are our management actions having the desired effects? Are we contributing to the expansion of desirable/targeted habitats and subsequent increases in fish and wildlife?

In order to use these tools effectively, natural resource organizations will have to improve coordination and collaboration with each other. This collaboration will lead to the development of more comprehensive data and more efficient use of resources. Data sets can be expanded and shared. Funding can be leveraged. Key spatial and temporal indicators or benchmarks can be jointly developed that can be used to provide a better understanding of variation in performance over a range of conditions, supporting better analysis. Better decisions on future directions should result from the evaluations. The evaluation will also allow better communication with the public on the effectiveness of the programs.

Who will Benefit from Adaptive Management?

Three significant groups will benefit from adaptive management. Agencies and organizations will be able to provide better information and a more efficient use of resources. The improved information will help the organizations in their outreach efforts with constituents and elected officials. These improvements could result in increases in budgets due to improved performance on accountability measures (indicators/benchmarks). The public benefits from an improved natural resource base at a net savings. Most importantly, natural resources will benefit. With better data, better decisions can be made. Corrections or adjustments in project and program design and implementation can be made early with more data and improved coordination that are part of adaptive management.

When and Where Is it Appropriate to Use Adaptive Management?

Adaptive management is appropriate for all programs. The following case studies illustrate the benefits. Coordination between federal, state, and conservation NGOs can build on successes. Regional applications can be better met via this process by minimizing replication. Partnering with others and sharing data can allow you to use scarce resources more efficiently.

How Can You Gain Efficiency with Adaptive Management?

Adaptive management is a better process for making better decisions. Better decisions should lead to better project implementation and results. Through more effective management and programs, you will be in a position to establish a record of success and communicate that success to both your constituents and your political leadership.

Better trend data enhances the science and better documents result. This allows for better accountability of programs. You may be able to clarify the cause and effect relationship between management actions taken and responses in habitat conditions and population enhancements.

So, if you successfully seek to employ both adaptive management and monitoring and evaluation, you will have to be able to answer these questions:

1. Do I do my monitoring and evaluation alone as an agency/organization?
2. Do I coordinate with other federal and state agencies and conservation NGOs in monitoring and evaluation activities?
3. Does the public understand my research goals?
4. Is there a relationship between information, management decisions, and monitoring and evaluation data and the changes in public attitudes toward the agency?
5. Is the monitoring information used adaptively and linked to agency policies?

Indicators/Benchmarks—How Do You Utilize Indicators to Evaluate Progress?

In order to evaluate projects and to make midstream corrections if necessary, you need to develop and institutionalize a system of tracking a set of indicators that monitors soil, water, air, and wildlife. These four indicators are interrelated. The information can be used to inform decision-makers of the status of each program or project.

Once indicators are identified, you'll be in a better position to answer the question: "Are fish and wildlife conditions stable, declining, or improving over time?" The answer can then be connected to policies, laws, and goals established by fish and wildlife agencies. There should be a correlation between the agencies' goals and the indicators you chose. Remember, there are multiple audiences that you need to be working with so how you select the indicators often will determine their acceptance by targeted audiences. Since we are focusing on Farm Bill conservation programs, it would be appropriate to also look at the social and economic implications of indicators.

Case Studies

These case studies describe how adaptive management is being applied on the ground. The Thunder Basin of Eastern Wyoming case study and the Monitoring and Evaluation Plan for Habitat Buffers for Upland Birds (Northern Bobwhite Quail Buffers) case study apply adaptive management principles to specific Farm Bill conservation practices. The other case studies, The Tidelands of the Connecticut River case study and the Oregon Salmon/Watershed Project case study, while not Farm Bill-specific, describe projects that demonstrate how adaptive management can and should be applied to Farm Bill conservation practices.

Thunder Basin of Eastern Wyoming

Jonathan Haufler, Ecosystem Management Research Institute, Seeley Lake, MT

The Thunder Basin Grasslands Prairie Ecosystem Association (Association) is a non-profit organization established to provide private landowner leadership in developing a responsible, common sense, science-based approach to long-term management of private lands. Members in the Association consist of private property owners, primarily ranchers and energy production companies, within a designated 931,000-acre mixed-ownership landscape in eastern Wyoming. This landscape is recognized as one of the most ecologically significant grasslands in the United States.

The Association was formed in 1999 to address growing concerns about land management with particular interest in activities related to ranching, coal mining, coalbed methane development, and oil and gas production, and the influences of these activities on a number of wildlife species of concern. The Association's goal is to maintain responsible economic use of the land while demonstrating how effective

stewardship of natural resources can be provided through voluntary, privately led, collaborative efforts.

The Association recognized that each landowner working independently would not be as effective as a collaborative effort that considered the cumulative contributions of all lands within the landscape for ecological, economic, and social objectives. Consequently, the Association focused its efforts on developing an ecosystem management plan that addressed the habitat needs of all species of concern while balancing those needs with sustainable economic and social activities. The ecosystem management plan will provide the science-based information and integration needed to meet these objectives and will provide the basis for landowners to implement appropriate strategies.

The Association obtained a pooled Environmental Quality Incentives Program (EQIP) grant, with additional funds from the Wyoming Wildlife and Natural Resources Trust Fund and Wyoming Department of State Lands and Investments to restore and manage the declining habitat of a number of species of concern. These species included the long-billed curlew (*Numenius americanus*), upland sandpiper (*Bartramia longicauda*), chestnut-collared longspur (*Calcarius ornatus*), lark bunting (*Calamospiza melanocorys*), McCown's longspur (*Calcarius mccownii*), mountain plover (*Charadrius montanus*), short-eared owl (*Asio flammeus*), plains sharp-tailed grouse (*Tympanuchus phasianellus*), and swift fox (*Vulpes macrotis*). The Association is applying specific conservation treatments to 3,250 acres spread across 13 pastures in an active-adaptive management design. These treatments are designed to restore specific grassland conditions within the Thunder Basin that are in decline relative to the historical record.

Treatments were designed to produce specific plant communities across three different types of ecological sites. Three treatments will be used in combination: prescribed fire; inter-seeding with selected native species; and herbicides to control cheatgrass (*Bromus tectorum*), an exotic invader. In addition, several grazing regimes are being applied to pastures following these treatments. The Association expects to produce the desired plant community conditions through responses to the treatments. However, it is not well known how the plant communities will respond to the specific combination of practices. Therefore, treatments will be replicated and monitored to provide information for adjustments to future treatments.

The Association selected three sets of pastures that averaged approximately 1,000 acres in size to replicate a desired range of ecological sites: five pastures were composed of primarily of clayey sites; five pastures were composed of primarily of loamy sites; and three pastures were dominated by saline conditions. The treatment portion of each pasture was left ungrazed prior to treatment to build up fuels for prescribed burning. In each pasture, prescribed burning is being applied to 240 acres in late summer/early fall. The burned areas will receive rangeland planting on two-thirds of the area (approximately 160 acres) as inter-seeding with a native seed mixture appropriate for that ecological site that emphasizes species known to have decreased in occurrence and dominance due to past grazing and other factors. Approximately 80 acres of each burn will remain unseeded to allow for the determination of the response of native plants to fire without the inter-seeding. In addition to seeding, half of each burned area (approximately 120 acres of each pasture) will be treated with an herbicide in fall to control cheatgrass.

The Association will apply varying levels of prescribed grazing as an additional treatment, with an entire pasture being the treatment unit. The treatments, with the varying levels of grazing, should result in different vegetation responses in both the treatment areas as well as areas of each pasture outside of the treatment area.

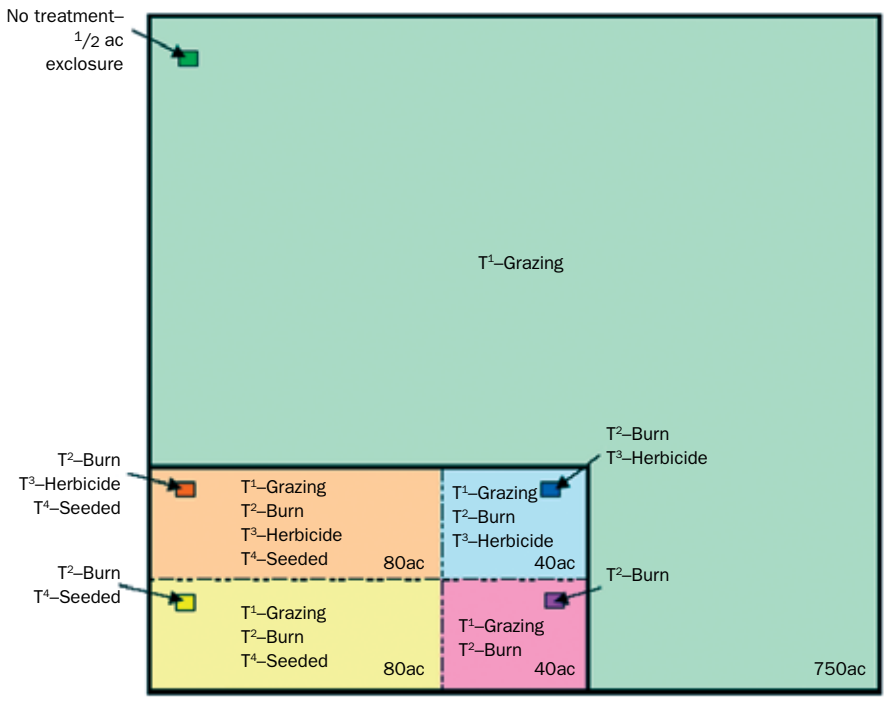
In each pasture, five exclosures of approximately one-half acre will be constructed, with one exclosure placed in the burned/planted/herbicide treated area, one exclosure in the burned/planted area, one in the burned/herbicide treated area, one in the burned-only area, and one in the untreated area of the pasture that is open to the specific grazing treatment. These exclosures will provide for an ungrazed control for each treatment combination in each pasture for monitoring purposes.

Monitoring, beginning in 2006 with pre-treatment measurements, will document the response of each pasture for vegetation conditions and wildlife use (plot sampling of bird use) to determine if the desired conditions for ecosystem diversity and associated habitat conditions for species of interest are

obtained. Monitoring for each treatment combination (Figure 2) will be continued for a number of years post-treatment to identify the vegetation and wildlife responses.

The pooled EQIP grant will support conservation needs at a landscape scale and will also improve rangeland productivity for each of the producers involved in the project. The treatments are designed to produce a significant acreage of desired conditions to meet the management objectives. By pooling the funds and using an adaptive management framework, the results will allow for an evaluation of the effectiveness of each practice and its combination applied across different ecological sites. This design will allow future treatment programs to focus efforts on those practices that produce the best results in this landscape and increase the effectiveness and efficiency of future Farm Bill funding. Monitoring associated with the project will document the responses of the plant communities and selected wildlife populations.

Figure 2. Treatment applications within a schematic 1,000 acre pasture. Practices to be applied include prescribed burning, rangeland planting, pest management-chemical, prescribed grazing, and fencing. In combination, these practices are designed to provide restoration and management of declining habitats to restore desired ecosystem conditions as described by ecological site descriptions. Exclosures (1/2 acre in size) will be placed in each treatment area to monitor the effects of each treatment combination in the absence of livestock grazing.



Monitoring and Evaluation Plan for Habitat Buffers for Upland Birds (Northern Bobwhite Quail Buffers)

L. Wes Burger, PhD. Mississippi State University, Mississippi State, MS
http://teamquail.tamu.edu/publications/HabitatBuffersforUplandBirdsCP33.pdf

The U.S. Department of Agriculture's Farm Services Agency (FSA) Notice CRP 479 required development and implementation of a monitoring program as a precondition for states receiving their Habitat Buffers for Upland Birds (CP33) allocation. Specifically:

"A monitoring and evaluation plan must be developed in consultation with the state technical committee, including the U.S. Fish and Wildlife Service, State Fish and Game agencies, and other interested quail parties. The plan must provide the ability to establish baseline data on quail populations and estimate increasing quail populations and impact on other upland bird populations as a result of practice CP33, Habitat Buffers for Upland Birds, including the following:

- verification that suitable Northern Bobwhitequail cover is established
- verification that appropriate cover management practices are implemented on a timely basis
- states must control acreage within their allocation
- implementing a statewide sampling process that will provide reliable estimates of the number of quail per acre (or some other appropriate measure):
  - before practice CP33, Habitat Buffers for Upland Birds, is implemented (baseline)
  - resulting from the established CRP [Conservation Reserve Program] cover."

The research committee of the Southeast Quail Study Group (SEQSG)

developed a suggested national protocol for monitoring northern bobwhite (*Colinus virginianus*) response to CP33 that could be deployed through a combined effort of state offices of USDA-FSA/Natural Resource Conservation Service (NRCS) and state resource management agencies to: 1) provide statistically valid estimates of northern bobwhite density (or some other appropriate measure) on fields enrolled in CP33 at state, regional, and national levels and 2) provide a measure of the relative effect size of the CP33 practice. The protocol suggested a framework for monitoring breeding bobwhite and grassland songbirds using point transect methodology and fall bobwhite density using distance-based fall covey counts. The FSA national office, SEQSG, Southeastern Association of Fish and Wildlife Agencies (SEAFWA) directors, and Association of Fish and Wildlife Agencies (AFWA) have endorsed this protocol in concept. Furthermore, Southeast Partners in Flight (SEPIF) has expressed a commitment to assist in breeding season songbird monitoring and dovetail winter grassland bird monitoring on this sample of contracts. SEPIF has already provided much needed guidance regarding non-game bird monitoring in the CP33 monitoring protocol. A grassland songbird monitoring protocol also is available at http://teamquail.tamu.edu/publications/HabitatBuffersforUplandBirdsCP33.pdf.

The team initiated monitoring in 2006. AFWA is assisting states with carrying out the monitoring. Mississippi State University coordinated sample selection and sampling packet assembly, and is assisting with data analysis.

The Tidelands of the Connecticut River

Nels Barrett, USDA, Natural Resources Conservation Service, Tolland, CT,
Paul Capotosto, Wetland Habitat and Mosquito Management (WHAMM) Program, Connecticut Department of Environmental Protection, N. Franklin, CT

The Tidelands of the Connecticut River Habitat Restoration Project is a cooperative effort to restore the ecologically unique habitat for a diverse group of organisms in the landscape where the Connecticut River meets Long Island Sound. The wetlands, ranging from fresh to saline, provide many ecosystem services, including flood storage, upland buffering, water quality improvement, resource production, recreation, transportation, and aesthetics. Native biological diversity and the integrity and health of this system are threatened by an invasive species, the common reed [*Phragmites australis* (Cav.) Trin. Ex Steud.]. *Phragmites* has spread unchecked, achieving near exclusive dominance in many tidal marshes along less saline reaches [See Figure 3.] Management of the threat and recovery of the system requires *Phragmites* control.

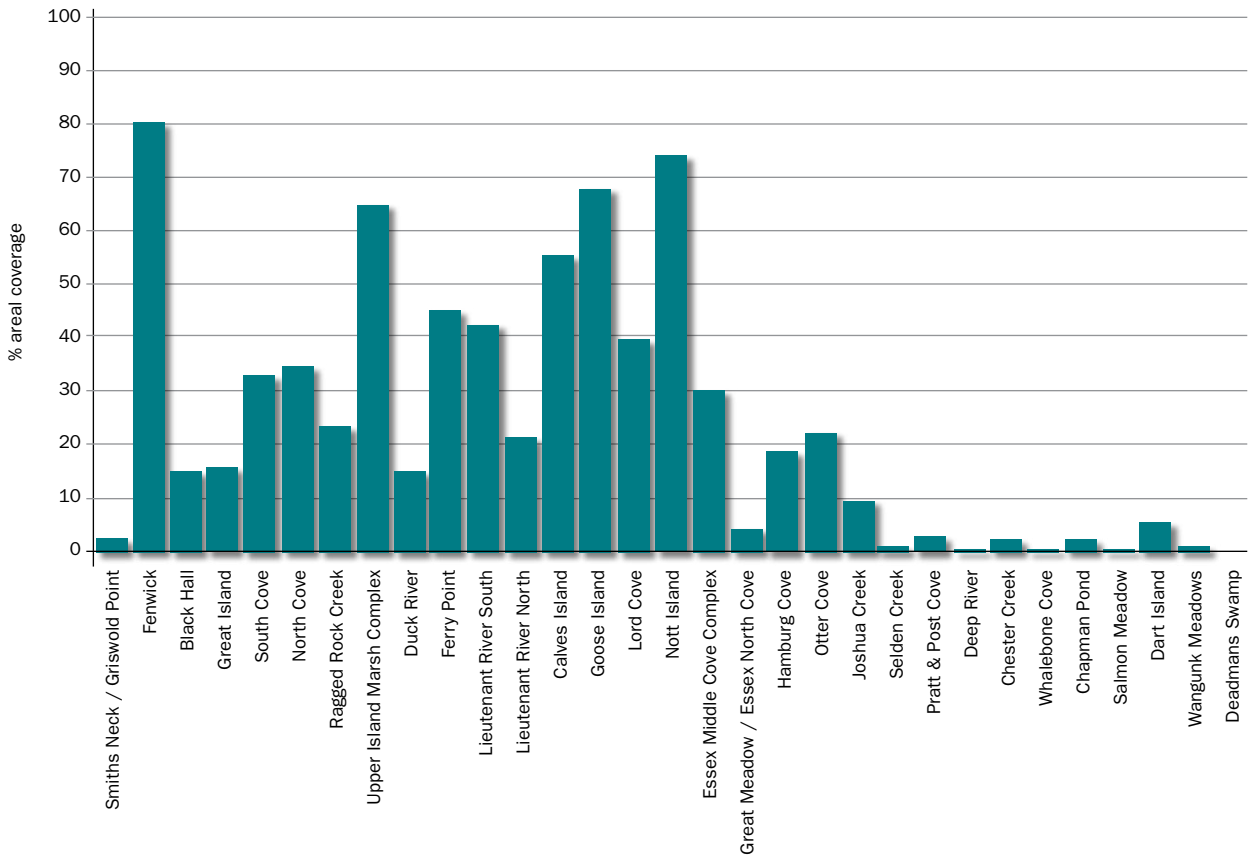
Numerous governmental and non-governmental organizations came together to create a partnership-based institutional structure, the Habitat Restoration Initiative Committee, and to establish a common vision of success. The partnership required a commitment of resources from modeling to on-the-ground restoration activities, monitoring, and outreach. Cooperation required clarification of restoration issues and needs, clear goals and objectives, a means for facilitating partnering, and a peer-review process. The assumption is that once *Phragmites* is controlled, the native vegetation will return. A key milestone was the development of the restoration project plan. The partnering structure facilitated participation and peer review. The effort formally began with work assessing biophysical and social realms, developing a conceptual model, and explicitly stating the assumptions underlying the goals of restoration and identifying social values.

The Habitat Restoration Initiative Committee decided to proceed sequentially so that, as restoration practices and treatments were completed at one site, new project sites were initiated. To date, three sites have been completed, one is in process, and six have been planned.

Regular monitoring of *Phragmites* and of rare plants was incorporated into the plan to determine the effectiveness of on-the-ground efforts and to identify areas of uncertainty that could affect the long-term success of the effort. Monitoring was necessary because *Phragmites* tends to re-invade and may require repeated control measures. Monitoring was also necessary to ensure that rare plant species were not adversely affected by the treatments.

Scientists and managers involved in the projects used the data from monitoring to re-evaluate previous steps and thereby establish a feedback loop on the effectiveness of treatments. Monitoring data were

Figure 3. *Phragmites* saturation in Tidelands of the Connecticut River



also used in performing outreach with the public to engage their interest and to continue the momentum toward achieving the project goals.

Representatives of the following groups partnered in monitoring—Related Activities Conservancy, Tidelands of the Connecticut River, Potopaug Gun Club, Connecticut Department of Environmental Protection, Migratory Bird Stamp Program of Connecticut, Stewart B. McKinney National Wildlife Refuge, Silvio O. Conte National Fish and Wildlife Refuge, the U.S. Fish and Wildlife Service, the Connecticut state office of NRCS, and the National Fish and Wildlife Foundation.

The Tidelands Plan employs a sequential landscape-scale management strategy as the most effective way to eradicate *Phragmites* and restore the biological integrity of the wetland systems. The sequential treatment of discrete sections was decided upon as a means for "learning from doing" and for improving the cost-effectiveness of efforts to restore Tidelands ecosystems. Data gathered were geo-referenced into a Geographic Information System (GIS).

The adaptive management (AM) approach has led to changes in how the project is implemented and the longer-term effort to control *Phragmites* is conducted. Eradication efforts now focus on treating one section at a time, evaluating the effectiveness of the treatment from monitoring data and then making adjustments to the treatment practices at subsequent sites. This sequence of treatment, monitoring and evaluation, and adjustment is repeated at each subsequent site. The cost of treatment at each new site declines. The result has led to steady improvements of the control practices at each site with a concomitant increase in overall cost-effectiveness of the effort to eradicate *Phragmites* and restore the Tidewater ecosystem.

Lessons are still being learned on how to restore Tidelands ecosystems. Experience with AM up to now has shown that the assessments improve ecological understanding. Similarly, the partnering and out-

reach components of AM can help to communicate this understanding to scientists and managers and the general public, to redeem social value, and to foster an organizational culture of responsiveness.

Oregon Salmon/Watershed Project

Stan Gregory, Oregon State University, Corvallis, OR

The Oregon Plan for Salmon and Watersheds (Plan) is a cooperative effort to restore salmon runs, improve water quality, and achieve healthy watersheds and strong communities across the state. To contribute to this vision, the Plan relies on volunteers, creating a combination of voluntary and regulatory actions to conserve and restore watersheds and stocks of Pacific salmon. This cooperative paradigm drives the effort and remains the cornerstone to achieving success. This effort began with the creation of an implementation team that reviews and coordinates watershed restoration priorities. Members from federal, state, and local governments and tribal agencies have responsibility for activities contributing to watershed protection and restoration. A charter was endorsed by representatives of Oregon's state agencies who agreed to support the Plan.

With a formal infrastructure in place, the critical component of a monitoring and evaluation plan was established in March 1997. Its purpose was to 1) establish a structure and identify responsibilities for the development of monitoring teams, 2) coordinate and evaluate the monitoring efforts of the state agencies, federal agencies, and citizen groups and 3) annually review the progress of the monitoring program and explore the information emerging from the joint efforts. An independent multi-disciplinary science team provides an ongoing review of the scientific foundations of the Plan to the state. The monitoring program solidified the interagency commitments to the Plan, including coordination of public and private monitoring activities.

Representatives of the following groups participated in monitoring-related activities:

State: Departments of Agriculture, Environmental Quality, Fish and Wildlife, Forestry, State Lands, Transportation, and Water Resources; the Governor's Natural Resource Office; Oregon Watershed Enhancement Board; and legislative committees on natural resources.

Federal: National Marine Fisheries Service, U.S. Fish and Wildlife Service, U.S. Environmental Protection Agency, Forest Service and Bureau of Land Management.

Tribal: Columbia River Intertribal Fish Commission.

Partners: Oregon State University, Dept. of Land Conservation and Development, Watershed Councils, some soil and water conservation districts, landowner groups, environmental community and individuals.

Monitoring is a systematic collection of information used to assess the current conditions and trends in critical resources, ecological processes, or environmental conditions. Factors that affect the status and trends in salmon populations such as habitat conditions, water quality, watershed health, fisheries harvest, fish hatcheries, predation by birds and mammals, and ocean conditions are also monitored. The Plan's monitoring was designed to measure those factors needed to describe relationships between populations, habitats, restoration actions, natural processes, human activities, and management actions.

Because salmon require well-connected and intact habitats from headwaters of watersheds to ocean feeding grounds, the Plan endorses management with a landscape perspective as the most effective way to accomplish meaningful contributions to long-term salmon recovery in Oregon and the Pacific Northwest. The Plan's focus on habitat restoration at multiple scales across watersheds encourages voluntary land-use practices known to effectively improve not only local conditions but also watershed conditions critical to sustained salmon populations. The major land use and geographic areas considered in planning efforts included virtually all parts of Oregon with watersheds that drain into the Pacific Ocean. This area includes eastern Oregon drainages of the Columbia and Klamath basins.

Successful implementation of the Oregon Plan for Salmon and Watersheds depends on partnerships between state agencies and stakeholders in specific sub-basins and watersheds. Thus, in October 2002, a charter agreement for regional team coordinators was created to develop biennial work plans identifying key objectives, priorities and collaborative actions to support implementation of the Plan.

Coastal Coho Project and Assessment (coastal watersheds)

The Coastal Coho Assessment is the starting point for more effective future restoration investment, monitor-

ing, and adaptive management action. The objective of this effort is to assist in the recovery of one of the species of salmon that depends on Oregon watersheds. This assessment includes: viability analysis, population bottlenecks, evaluation of conservation efforts, monitoring, evaluating current threats, and lessons learned with a commitment to adaptive management.

Key conclusions of the assessment points can be found at www.mtjune.uoregon.edu/website/OWEB/Assessment. One of the key findings related to adaptive management included "maintaining a comprehensive monitoring program to allow adaptive management of conservation efforts as new information is gained."

Actions Taken as a Result of Adaptive Management

In reviewing the factors for coho salmon decline, it was determined that changes were needed in the fishery harvest, hatchery management, and habitat protection and restoration in forest, agricultural, and urban lands. Major modifications of fishery harvest and hatchery management were implemented. Direct commercial harvest of coho salmon was totally eliminated from 1998 to 2002, followed by low rates of harvest to the present. Several hatcheries were closed and brood stock management and release practices have been modified to minimize the potential for adverse impact on coastal coho salmon. Now reduced numbers of hatchery coho salmon are released in only seven of 19 populations. This decrease in released fish and attention to locations of hatchery releases are intended to lessen genetic interactions, competition, and predation. Enhanced habitat management included protection, riparian restoration with extensive tree planting and fencing, in-stream improvements, development of additional forest management plans, improvement of culverts and bridges, confined animal feeding operation programs, total maximum daily load plans, and weed and invasive species control.

Lessons Learned

The assessments demonstrated Oregon's responsiveness to new information and a willingness to implement needed changes in management programs. Examples included extensive restoration efforts of watershed councils, improved forest practice rules, improved water quality management plans by agriculture, reductions in fishery harvest rates, and redesign of hatchery management policies. These changes represent significant departure from historic practices, based on data and analysis. The state reviewed the status of coho salmon in 2005 and concluded that the coho salmon stocks of coastal Oregon were minimally viable. Based on the quantitative data developed collaboratively through the Oregon Plan for Salmon and Watersheds, the state recommended that the federal government remove coho salmon from the endangered species list. Both state and federal reviewers of the assessment noted that this assessment would not be possible in most states or for many resources and applauded the coordination of the monitoring program with the management actions of the Oregon Plan for Salmon and Watersheds.

A Reality Check—Adaptive Management: Myth and Reality

Jay Nicholas, Oregon Department of Fish and Wildlife, Salem, OR

The Oregon Department of Fish and Wildlife used adaptive management to assist in its decision-making process. Adaptive management is not just tweaking around the edges of natural resource issues; it implies significant course corrections. Under adaptive management, theoretically, monitoring provides data, data generates information, and agencies learn from the information and generate changes to management programs that are more effective in producing desired natural resource outcomes. In theory, adaptive management is just that simple. It is logical. It is timely.

Nonsense.

Here's the reality. Adaptive management (change) can be achieved, but it can only be achieved slowly, in the proper time, and it requires some key ingredients. These are:

- leadership
- data
- patience
- public support

Of these four ingredients, data are possibly negotiable, the others are not. Leadership can come from elected officials, agency directors, charismatic individuals, or the public. Depending on the circumstances of the issues, leadership may be bold or timid.

Leadership may truly be out in front of the public or it may actually be following public sentiment. But someone, somewhere, has to lead, or create the appearance of leading the change.

Data should be a crucial ingredient in adaptive management but, in reality, it may or may not be. Sometimes, the data to support change in natural resource policy or programs are overwhelming and indisputable—yet it will be ignored, minimized, or disputed. This is where patience comes in. The facts may signal a need for change, but the time may not be right for the change to be implemented. Under these circumstances, those who see the need for change must be patient and not throw themselves unnecessarily or prematurely under locomotives that are not yet ready to be moved. Under these circumstances, one must wait for the leadership and public support to achieve sufficient momentum—then adaptive management can be implemented. At this moment, whatever data are available (from scant to extensive) may be cited as evidence for the needed change.

Examples? Over the course of my career I have seen extremely significant changes in management of fishery harvest and hatchery practices in Oregon. These changes were needed and valid well before they were actually implemented, by perhaps two or three decades. A shortage of data did not slow implementation of change; neither was change ultimately achieved solely on the strength of new data. Society and the leaders were not ready to accept or push for the change.

The Oregon Plan for Salmon and Watersheds is an example of timely, effective leadership that produced a new approach to natural resource management in Oregon. The Oregon Plan incorporates many recently changed management philosophies and practices, including fishery management, forestry management, water quality management, and restoration management. These changed philosophies and practices, together, reflect genuine examples of adaptive management and offer real hope for more effective and sustainable management of natural resources.

The time was right to initiate this plan when it was conceived and launched. Success was achieved because the agency was ready to accept adaptive management as a strategy to make better natural resource decisions. As a result, the effectiveness of conservation practices was enhanced. ■

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